

Equilibrium

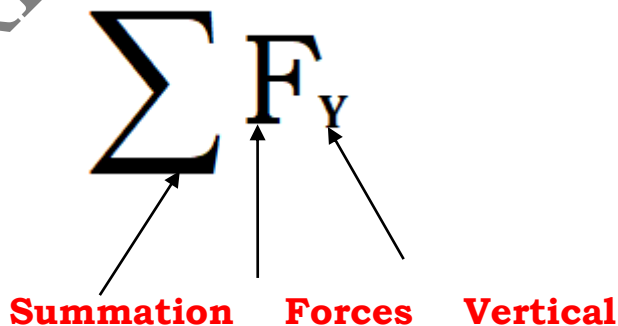
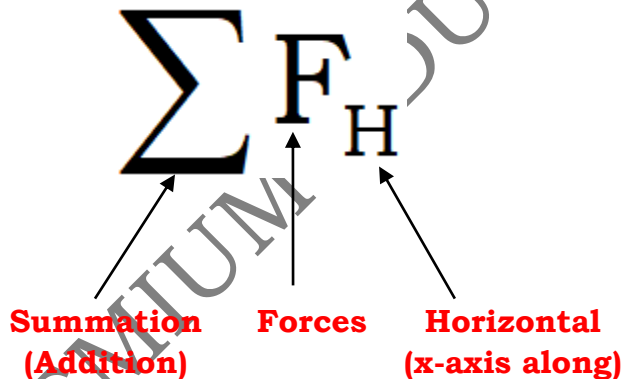
“Any system of forces which keeps the body at rest is said to be in equilibrium”.

Conditions of Equilibrium:-

1. For coplanar concurrent Forces

$$\Sigma F_H = 0 \quad \text{or} \quad \Sigma F_X = 0$$

$$\Sigma F_V = 0 \quad \text{or} \quad \Sigma F_Y = 0$$



where,

$\Sigma \mathbf{F}_H = \mathbf{0}$, Algebraic sum of components of all forces along **X-axis** must be equal to Zero.

$\Sigma \mathbf{F}_V = \mathbf{0}$, Algebraic sum of components of all forces along **Y-axis** must be equal to Zero.

2. For coplanar non-concurrent Forces

$$\Sigma F_H = 0 \quad \text{or} \quad \Sigma F_x = 0$$

$$\Sigma F_V = 0 \quad \text{or} \quad \Sigma F_y = 0$$

$$\Sigma M = 0$$

where,

$\Sigma \mathbf{F}_H = \mathbf{0}$, Algebraic sum of components of all forces along **X-axis** must be equal to Zero.

$\Sigma \mathbf{F}_V = \mathbf{0}$, Algebraic sum of components of all forces along **Y-axis** must be equal to Zero.

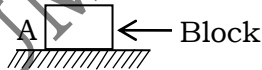
$\Sigma \mathbf{M} = \mathbf{0}$, Algebraic sum of moments of all forces about any point in their plane must be equal to zero.

Free Body Diagram (FBD)

If all **active** and **reactive** forces acting on a free body are shown, the diagram is known as Free Body Diagram (**FBD**).

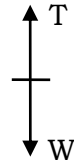
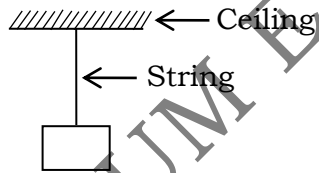
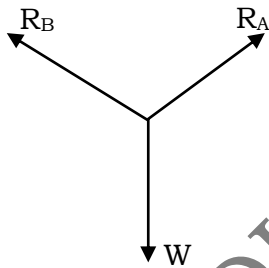
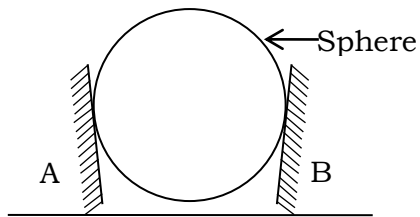
Active Force = (Applied force and weight of a body)

Reactive Force = (Floor, String, Hinged roller support, cables)



↑ **R** **R**: Reactions offered by Floor

↓ **W** **W**: Weight of the Block



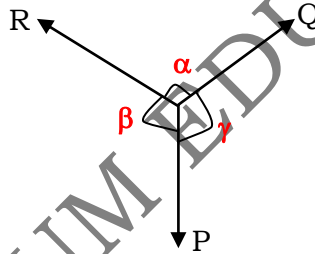
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Lami's Theorem

(Equilibrium of three coplaner concurrent forces)

Statement

“If three forces acting at a point on a body keep it at rest, then each force is proportional to the sine of the angle between the other two forces.”



Mathematically,

$$\frac{p}{\sin \alpha} = \frac{Q}{\sin \beta} = \frac{R}{\sin \gamma}$$

α = Angle between Q and R

β = Angle between P and R

γ = Angle between Q and P